Biegler (A. P.)

Alphabet Boy

ANATOMY AND PHYSIOLOGY

OF THE

Brain and Nervous System,

By AUG. P. BIEGLER, M. D.

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OF THE

BRAIN AND NERVOUS SYSTEM,

AN ESSAY

READ TO THE

ALBANY PHRENOLOGICAL SOCIETY,

APRIL 3, 1840.

By AUG. P. BIEGLER, M. D.

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ESSAY.

GENTLEMEN:—

It will, I trust, be unnecessary to tell the members of a Phrenological Society, how indispensable and necessary to the students of phrenology, a knowledge of the anatomy and physiology of the brain is. The aim of our society, being the propagation and perfection of that science, in behalf of which we are this evening assembled, I thought it might not be amiss to convey, in the form of a slight sketch, the fundamental ideas of an anatomy of the brain and the nervous system.

I am not in the least unconscious, in what difficulties and obligations it involves him, who undertakes this task, the more so, if, as it happens to be the case with me, the time allowed for its execution is so short. At the same time being deeply impressed with the importance and magnitude of my task, I am also fully aware of the inadequacy of the talents I can bring to the execution of it.

I would therefore much rather have seen the subject treated by some member who would have been better able to do it justice; if my name had not appeared first on the roll, and if I had not the satisfaction left, to continue and complete at a future period, the remarks I intend to make this evening. What, I however, chiefly rely upon, is your kind indulgence, which, I feel almost convinced, will not be withheld from me.

The organs of the circulation of blood, of nutrition, those of motion, of the voice and language, are, I am disposed to believe, well understood by the members of this society. The theme of our remarks therefore will be those internal springs of action, on the particular and various activity of which, the motion of the machine depends, the nerves and the spinal marrow, the brain, the senses and their several functions in a state of health.

The mere attractive force of the elements without the nerves, might, according to the law of gravity, *possibly* cause an *inspiration* but no *expiration*, a *reception* but not a *separation* of food; without the nerves, there would be no animal heat, no voluntary motion, no voice nor language. The animal exists because it feels. But never would it feel or perceive the broad stream of co-existence and life, if it followed that stream as passively and resistlessly as the plant, if it did not rather cross and oppose its current. The rays of the sun would no where be recognized or seen as light, if they were not thrown on an opake orb. The storm is only audible, when it encounters resistance, in the shape either of a dense body, or the less violently agitated mass of air itself.

This reminds us of the old problem of Pythagoras; if there were but *one* number, and no difference in numbers, there would be neither sensation nor life. Because the tertia, quinta and octava are different numbers from that of the fundamental tone, these strings will be touched instantaneously and in an audible manner. If there were neither number nor voice, but that of the fundamental tone, there would be no audible accord.

That we breath; that from the heart the blood rushes to all parts, and returns through the veins; that in the stomach and intestines food is changed into chyme and then into chyle, and is as such communicated to the blood; that flesh grows; that it falls away as if touched by the sirocco; all this we *feel* not.

The sense of feeling in a healthy state of the body is unconscious of that matter which passes through our system, except during the functions of entrance and egress *to* and *from* the body. All those internal operations which continue, even during sleep, concern such parts of the body and functions, as, like the plants, are sunk in the general stream of existence, obeying without resisting it. This is the sphere of action for the organs of involuntary motion, which move *without* and even *against* the will of man, and without his being conscious of it; because with *them*, there prevails another and more general cause of *being* and *counteracting*. That the different parts of the body have a visible existence, is caused by the force of gravity, which endows and preserves even the stone in existence.

But the mineral kingdom, and generally all inanimate nature, possess nothing but *gravity*; the mineral kingdom exists only for the sake of its superiors, there is nothing below it existing for *its* sake. That our body is renewing itself every moment; that it thrives and lives, is done by the magnetic power of cogeneration, which pervades all that lives; *that Physis*, which carries also with *itself* a being for the sake of all others, but which has not only some superior or equal for the benefit of which it exists, but also something inferior, existing for *its* sake and to which the current of existence, as if in obedience to the law of gravity, is directed from above.

But that, finally, *we feel* and *know* is caused by force of a spontaneous and independent motion; by the broad stream of existence, crossing or opposing it. Only those parts feel distinctly which obey our will, by which they may be moved, or at least stimulated to greater activity and attention or may be put to rest. Here, too, as in the existence of vegetable life, or the nutrition of the body, we see a general motion at work, which, opposed to the current of existence, supports animal life. We observe the same motion, which during the act of generation introduces the soul into the individual body, but afterwards in death removes it again.

In order, however, to make it possible for the vital power to influence the body, a receiving, absorbing conductor is required; a conductor apparently motionless and within reach of the current. This conductor in the human body is especially the brain, of the properties and construction of which, we propose to give a slight sketch.

In a majority of organs, the functions for which they are created, are recognized at the first view. From the form of the hand and fingers, we conclude their design is to seize; from that of the foot, to support the body, and the province of the teeth we know to be the mastication of food.

But what eye can see into the structure of those threads (or filaments,) which run in branches from the brain and spinal marrow into the flesh and cellular tissue (textus cellosus) of the separate members, that wonderful double power, which with the speed of lightning, conducts the moving will to the limbs and the impressions of an external world to the brain?

This hemisphere of coagulated glaire, with its labyrinthine convolutions and variously crossing chambers, which commands all parts of the body, how can it impress upon us the belief, that in the secresy of its existence, rests the beginning of those channels which guide to the mortal frame, that point of action where a superior, eternal empire of thoughts and feelings is joined to, and often disguised in, the nature of flesh and blood.

Why the oxygen of the atmosphere, during the process of inspiration is absorbed by the blood, is understood from the manner in which the latter is mixed; which mixture even after the blood is separated from the body, imparts to the former a property of attracting oxygen towards it.

How the light passes through the transparent membranes and departments of the eye, and sound through the windings and cartilages of the ear and finally reach the nerves, we may conjecture from the similarity of their structure with that of other bodies, which conduct light and sound; but what connexion is there between that tree-like form in the *cerebellum* and the thousand words and ideas, with which the spiritual tree, like leaves and blossoms, is loaded? What connexion between that wonderful being, *imagination* and the *commissura magna* and *nervus opticus*, between reason, its empire and the *twin-pair of fasciculi medulli* and their intimate, the conarium (or glandula pinealis?) What causes the nerves communicating with those parts, when severed, to refuse to the stomach the power to digest, to the lungs that of breathing and to every member its particular motion and feeling?

The object we seek is, we know, not *behind*, but *before* and *without* the mirror, in which we look for it. The brain itself is by its different organs, a conductor to an invisible beginning of life; which beginning is *above* and *without* life, as the nerve is a conductor of feeling and motion *to* and *from* the brain.

An inquiring mind, however, if it has such an aim as the knowledge of life, deems even the slightest trace of analogy, which perhaps indistinctly indicates the point to which to direct our reasoning powers, worthy of the most minute attention. I shall, therefore, first consider the external relations of the nerves.

The chemical element even of the brain and nerves must greatly excite our attention. It is glaire, half coagulated, and mixed

with much water. Glaire is, we know, that matter which every where in living nature, indicates, not a state of mature existence, but that of a visible capacity for growth and formation; that matter, from which in the grain we see spring the blaze and ear, in the bird's egg, the animal with all its parts.

We are conscious that in the germ of the egg the fundamental forms of life are condensed, however invisible to the eye of man. In the midst, therefore, of these sharply marked and corporeal formations of the body, there is something continually growing and capable of being formed; something always at rest, though surrounded by powerfully agitated members; something unborn or at least infantile in the midst of what is grown and matured.

And this is exactly the point where the animal body is accessible to the influence of spiritual life. Besides the coagulated glaire, there is in the brain an inconsiderable particle of lactate of soda and sulphur mixed with phosphorus, and the latter as an acid is also mixed with magnesia usta, *calcarea* and alkali.

Next to the chemical element of the brain, we will consider the external and internal structure of the nervous system.

The mass of the nerves is covered by a sheath of a strong, white, fibrous membrane. The latter may be divided in fasces (bundles) of fibres, whose connexion with a tender cellular tissue is but very loose. An observer intent on investigating further, might be deceived so far, as to see in those bundles the separate branches which run from the nerves to the neighboring parts, or vice versa, from them to the mass of the nerves, where they, for some time yet continue to run near and distinctly separate from each other. The separation of the bundles may be continued for some time longer in single threads, and these again in yet smaller threads, the latter of which present themselves under the microscope, as if composed of small balls, which are enclosed in a semifluent, and transparent medium. Those nerves which communicate with the organs of the senses, the muscles of voluntary motion, and with all those symmetrically arranged organs, which I shall have occasion to mention hereafter, end or begin their course, which *too*, is symmetrically arranged in the brain or the spinal marrow. The brain, with those parts situated next to it, seems, even as regards

weight and dimensions, to be in a just proportion to the head. The seven bones of the cerebral cavity, form a separate, indivisible whole, whilst the brain which is preserved in them, appears divided in a variety of parts which are all more or less plainly defined. But on the other side, the brainlike mass of the spinal marrow, remains in its whole course one uniform whole, composed of single cords, which run symmetrically beside each other. With every pulsation, the seventh part at least of the entire mass of blood is propelled to the brain, in consequence of which, the latter is so much extended, that the whole cavity is filled, whilst during the return of the blood they are separated from each other by some space between them.

It seems remarkable, that the blood vessels which communicate with the brain, viz: the *arteria carotis externa*, and interna, etc. before they enter, change their usual straight direction, whence several windings, and finally one *noose* almost in the form of a ring, are formed.

The revolving blood is soon collected from the interior veins into the adductors of the exterior hard membrane, which convey it in a short time back from the cavity of the brain to the heart. That hard membrane which is akin to the nature of the veins,* forms the extreme and particular investment of the brain, the exterior departments of which it divides like a partition. The tender internal membrane forms an immediate investment for the brain, and enters with its vessels of nutrition, which support the circulation of the blood in all the gyrations of the inner cavities, and comprises all the formations of the former.

Between the two membranes, the external and internal, which contain the blood vessels, we see the cobweb-like membrane, (tunica araehnoidea.) These three membranes invest also the spinal marrow in the same order.

After removing the hard membrane, as well as the small cobweb-like membrane, we come to the surface of the brain, which we find crossed by variously involved furrows (sulci.) The brain is divided into two distinct chief departments by the hard membrane. The first department is known under the name of *cere-*

* By receiving the returning blood.

brum, the second under that of cerebellum. The different form and direction even of these furrows, which appear involved and crossed in the cerebrum, and in the cerebellum as parallel and leaf-like sheets, lead to the conclusion of a difference in the construction of these two brains, and the individuality of the organs for each particular faculty.

The large anterior brain is again divided from above, into two side departments, by the sickle-like continuation of the membrane (falx), each of which departments is subdivided in a horizontal and vertical direction by distinct inlets, in three parts, and we may add as a *seventh*, the *cerebellum*. But even in the cerebellum we observe in each of its side departments, a separation into three parts, and here we may add as a *seventh*, (only on a smaller scale) the worm-like continuation.

The mass of the brain is composed of a soft grey substance, which by drying it in slices soon evaporates, and of a more solid white marrow. Between these two we observe in some points another of a yellow color.

The strata of the grey marrow form now a coat for the white, and then again the latter appears to be crossed by the former, in the cerebellum the changing strata of the two appear in the form of a tree with regularly extending branches. This is called the *tree of life.*

One glance into the interior of the brain must excite the attention even of an ordinary eye, and fill our minds with wonder and serious reflection. There is a symmetry, a connection, and proportion in the dimensions and distances of the parts, which prove the existence of a profound geometrical law.

In the centre of the brain rest those formations, which impart to the eye its ocular nerves (nervi optici,) and consequently to the body its temporal external light, those formations which in preference to other parts of the brain, we may consider as the corporeal vessel and mediatory organ of a spiritual light from above.

There are seven elevations, two large anterior, usually called *thalami nervorum opticorum* and four smaller posterior, called *eminentia quadrigemina*, but above and between these six, there

hovers as a superior being, the *glandula pinealis*, which environed by life, develops death; I mean the *acervulus cerebri*, which is a calcareous substance. Here is the beginning of the formation of the brain; for that bubble which we see in the fœtal child, or in the almost invisible embryo fowl, is nothing but the double pair of the *eminentia quadrigemina*. This appears distinctly formed in the brains of the lower classes of animals, and in the fœtus, even before the principal mass of the brain is visible, which, as a seed, includes and covers those manifold forms of the tree with all its organs.

The *eminentia quadrigemina* are even visible sooner than the *thalami nervorum opticorum*, which are first observed when the outlines of the eye appear.

The large brain, (cerebrum,) which in man is situated in the frontal part of the head, is also divided into three pairs of parts, and the thalami are immediately touched by the striped elevation, from which modern anatomy has separated the lensal bodies as separate, independent departments. Finally, we come to the cerebral processes, which lie nearest the surface, and from which the nerves of the olfactory organs proceed.

As a seventh, corresponding with the glandula pinealis, which lies on the posterior commissura of the brain, we find under the anterior commissura, the infundibulum, which conducts to the process of the brain; a part which seems but a repetition of the *glandula pinealis*, but in an inverted position. Filled with living breath, the lateral cavities extend their three pairs of chambers over the internal chambers of the brain, and in the centre of their side departments, we see a *third* cavity, connected with the former, and which afterwards, continued between the *eminentia quadrigemina* becomes a *fourth* cavity. Above the third, but separate from it, there is a transparent partition; this partition is formed by the *lamina* of the *commissura cerebri magna*, as an inferior part to which we may consider the *fornix*.

From this wonderful double part of the brain, which, like a shaft, separates the two lateral parts of the brain, come down in three different developments: 1. From the fornix, those small columns, which between the thalami and the corpus stria-

tum reach the eminentia medullata: 2. From the commissura magna, those elongations which in the declining lateral cavities, form the *cornua ammonis*, or the *pedes hippocampi*, and in the posterior chambers, the *pedunculi hippocampi*.

Thus we find here, as in all other regions of the brain, a display of the formations in three directions; and since the parts appear symmetrically on the right as well as on the left side, we perceive a division also into six, to which generally a single *seventh* may be added. The purpose of this division will be obvious to us, if, under the tuition of a master in the knowledge of the construction and history of the human body, we study the internal connexion between the different parts of the brain and the spinal marrow. I shall endeavour to explain, according to the best of my ability, this construction.

Of the spinal marrow in the fœtus, we see, first, two stripes of marrow, which in the beginning, grow together on the anterior side, whilst, towards the posterior, they are still separated, and form a deep channel in the form of a crescent.

After a lapse of time, this recess is closed towards the exterior, but in its interior, there remains a cavity of the spinal marrow, which, after birth, disappears almost entirely, and of which, in the adult body, we sometimes find a trace, where the spinal marrow enters the brain. The spinal marrow of an adult man may be compared to a cylinder, with somewhat flattened sides, but which gradually ends in a sharpened point on its lower extremity, and on its opposite extremity is like a flower, crowned with a blossom, the brain.

As from the marrow and of the rind of the stem of the plant, but more, from the parts of the bud, we may derive the parts of the blossoms, and may even recognize the latter in the former; so we can show the parts of the brain and their development, *in* and *from* the spinal marrow, but more from its bud, the prolonged marrow. This may be done in the following manner:

The two lateral parts of the spinal marrow are separated from each other, by two deep incisions (one *anterior* and one *posterior*) and are united only in the centre. Each of the two lateral parts is in its interior, composed of a gray substance, which forms the

spinal marrow, and of a mass which surrounds this gray centre in the form of a circle, in which we can distinctly recognize horizontal fibres. The gray centre of each part appears in the form of a *cornucopia*, curved towards the exterior like a crescent. These two horns (the corna anterius and posterius,) are united in the centre by a diagonal seam of the same gray mass. Before this gray streak, there is a white one, so that the anterior fissure is touched by the white commissura. The white mass of each half of the spine, is distinctly divided into three principal groups by the two horizontal fissures, by the form of the gray kernel and by the two furrows in which the anterior and posterior roots of the spine originate, and the first of which is directed to the rounded, the other to the pointed, part of the cornucopia.

The first of these groups extends from the anterior horizontal fissure of the spine to the furrow, in which the anterior row of roots of the spinal nerves originate.

The second or intermidiate group, which is situated in the crescent-like curve of the gray substance, is extended to the external, from the furrow of the anterior row of nerves to the posterior.

The third and posterior group is situated between the posterior furrow of the roots of the nerves and the fissures of the spine. If we compare the spine with the stem of that blossom which is developed in the brain, we may consider that part of it which enters the cavity of the skull as *medulla prolongata*, and forms here a joint between the spine and brain, the bud in which all parts of the blossom are distinctly formed, and perceived. But whilst the stem grows to a bud, we can observe great changes in it. Even externally we can, however, slightly perceive an increase of mass and a change in the direction, which formerly vertical, has now turned horizontally into the cavity of the skull. But internally it may be seen how the cords of the spinal marrow have abandoned their formerly parallel course, and instead of that, are now involved in each other in the most intricate manner, which causes the origin of three other groups, which, however, differ essentially from the spinal groups mentioned before.

Inferior Group.—The anterior cords of the spinal marrow re-

cede from each other, and the white commissura, which lies on the ground of the anterior spinal fissure, is by degrees elevated along the sides of the fissure and forms on the surface two small strings, separated from each other, to which, from the central string of each side, run *four* or *five* small bundles of marrow, which cross each other, so that those coming from the right go to the strings of the left, and those on the left to those on the right, whereby they are locked like the fingers of two hands. These two small cords, formed of fundamental and cross fibres and situated next to the anterior fissure, increase in mass the nearer they approach the larger lump, visible on the basis of the brain, (the *pons varolii*,) and form thus the *pyramids;* after this they pass through the *pons varolii* and appear again on the other side of the bridge, as crura cerebri, in connection with part of the fibres, coming from the (originally) anterior cords of the spinal marrow.

Superior Group.—The posterior cords of the spinal marrow form the basis of another group, which extends into the cerebellum. The cords of this posterior group become stronger by degrees, in the *medulla oblongata*; swell out in its centre, and begin then at once to diverge, and enter the cerebellum as *crura cerebelli.*

Centre Group.—The centre cord of the spinal marrow remains also the centre in the medulla oblongata. Some bundles of fibres in the anterior as well as posterior cords are added to it. The cord thus increased, continues its course beside the medulla oblongata, between the *crura cerebelli* and the *eminentia olivares* to the *pons varolii.* This cord forms the basis of the *middle brain.* By the separation of the posterior cords, the commissura above mentioned, which is situated behind the posterior fissure, is laid open. But previously to this the gray commissura as well as the whole of the medulla oblongata are divided by a leaf, which, beginning by crossing the pyramids along the medulla oblongata, runs vertically, and separates completely, the two grain-like bodies, which we mentioned above, as similar to a *cornucopia*, and the two lateral parts of the cords of marrow. This gray commissura, therefore, itself forms (as soon as it, by the separation of the posterior cords, becomes visible,) two cords which run parallel to

each other in the basis of the *fourth cavity*, which forms a deep fissure, situated between the *thalami*, and ends finally in the *infundibulum*, which, as above mentioned, appears as inverted *glandula pinealis*, under the *commissura anterior*, and conducts to the process of the brain.

The olivæ which are situated on the basis of the *medulla oblongata*, and between the pyramids and the lateral cords, contain a gray kernel with a dental edge, and are surrounded by a shell proper to them, and appear to have no connexion with the rest of the gray mass.

We shall now consider that triple formation, which we have already recognized in the spinal marrow and the medulla oblongata, a little more attentively in the brain, where it is formed by the small, middle and large brain.

The cerebellum entertains, through the superior group of the *medulla oblongata*, an immediate connexion with the latter. In order to form the cerebellum, the branches of the bridge and the eminentia guadrigemina are joined to the superior cords of the medulla oblongata above mentioned ; which union is the cause of an accumulation of marrow, in which a gray, dented kernel lies, the *corpus rhomboideum*, which bears great similarity to the *olivæ* of the *medulla oblongata*. From this accumulation of medullary substance, rise the leaves of the hemisphere of the cerebellum, and those departments which are coated inside with a gray substance. Whilst the cerebellum, by closing its two hemispheres, forms a cover to the *ventriculus quartus*, the cords of the larger or middle brain run *below* this cavity, and take their direction partly *over* and partly *across*, the *pons varolius*, the immediate cause of which formation is, that fasces of medullary fibres run in the interior of the cerebellum, from one hemisphere to another, and form thus a sort of ring. On that part of the bridge which is situated between the *crura*, and which extends to the cerebellum, we can distinguish three different strata, the lowest of which appears on the basis of the brain, and consists of the longitudinal fibres, which run mostly from one hemisphere of the cerebellum to the other. The middle and most powerful stratum has, also, longitudinal fibres, which are, however, of a more gray color, and crossed by the white

fibres of the cords, which come from the pyramids of the *cerebrum*. This middle stratum, after its expansion, has its longest course to the anterior part, and the larger part of the brain originates in it. The superior stratum of the *protuberantia annularis*, or the pons varolius, consists merely of longitudinal fibres intermingled with a gray substance. This superior stratum, which is a continuation of the middle group of the medulla oblongata, comes from the anterior edge of the bridge, as superior *crus cerebri*, *from* and *in* which the *eminentia quadrigemina* are developed, and also the *thalami*, *glandula pinealis* and the *infundibulum*. Both crura of the cerebrum, the last mentioned superior, from which a majority of the other parts of the brain are derived, are separated by a leaf like formation, and which divides the medulla oblongata into two lateral hemispheres. For this formation passes between the *crura cerebri*, and rises on the side of those branches which unite the *eminentia quadrigemina* with the *cerebellum* to the *eminentia quadrigemina*, the surface of which it covers, and whence it forms the superior stratum of the thalamus, in which the *nervus opticus* originates, and from which it descends through the ventriculus tertius to the basis of the *cerebrum* where it forms the sieve-like body of marrow, on which the *lensal body* rests, and by being continued towards the exterior, is finally lost in the rays of the *crus cerebri*.

The variously involved, elliptically curved channels are the ways in which the formations of the brain meet and intermingle in their fibrous texture of marrow, in each individual way they all meet, this is the case in the first mentioned seven of the interior optic organs, situated in the centre of the brain. There is a superior region, in which the sublime world of the spiritual is more distinctly reflected, than in any thing else visible to our corporeal eyes. We have here a presentiment of those seven fundamental powers, from which, as from a common fountain, emanates the life of the superior invisible and the inferior visible region, with all its different organs.

Twelve pair of nerves come through the cavity of the brain, from the organs of the cerebral mass. Of these, the first, second, fifth and eighth pair, are, properly speaking, *sensual nerves*. For

the first, is instrumental to the sense of smelling; the second to that of seeing; the fifth, which in the interior is divided into three branches, to that of taste; and the eighth to that of hearing. The third, fourth and sixth pair, going to the muscles of the eye, impart motion to the latter; the seventh to the lips and facial muscles; the ninth and twelfth are instrumental to the motion of the tongue; the tenth, taking its course towards the *larynx*, and finally to the *lungs* and *stomach*, imparts speech to the voice, and is, in its progress, frequently joined by the eleventh, which goes to the *shoulders* and *dorsal muscles*.

Every nerve of the *dorsal vertebræ* has its origin, as above mentioned, in two roots; the one of which comes from the *anterior*, the other from the *posterior* part of the spinal marrow. The former are instrumental to voluntary motion; the latter to the faculty of feeling in the nerves.

Thirty pair of nerves originate in the spinal marrow, eight in the *vertebræ colli*, twelve in the vertebræ dorsi, five in the vertebræ lumbares, and five in the *os sacrum*. Of these, the four superior pairs impart muscular motion and feeling to the neck and posterior part of the head, and the third and fourth pair to the nerves of the *diaphragma;* whilst the four inferior of the *nervi thoracici*, in connexion with the superior pair of dorsal vertebræ, form the *plexus cervicalis*, which is instrumental in the multifarious motions and activity of the arm, and the sensibility of the fingers. The other eleven pair of nerves of the dorsal vertebræ, are lost between the ribs, and the superior (the second,) has, at the same time, the duty of inspiring the *glandulae mammae*, and, in connexion with the four following pairs, that of putting in motion the superior muscles of the *thorax* and *dorsum*, whilst the two latter pairs especially, besides a part of the *diaphragma*, move also the *musculi lumborum* and *abdominis*, which, in connexion with the thorax, are active in the function of breathing.

The ten pair of nerves of the *lumbar* and *sacral vertebræ* form a particular *plexus* (texture,) for the protection of the thighs and feet. The lumbar and sacral nerves conduct, at the same time, the animating influence of the medulla spinalis to the lower region of the abdomen. The last pairs of nerves of the spinal marrow

as if they lacked the power of penetrating in the shortest way through the hard membrane of the spinal marrow, run for some time in company of each other and form thus on the end of the back the *cauda equina*, (horsetail.)

Where the nerves of the arms and thighs come out of the spinal marrow, the latter appears broadest and thickest. All nerves of the brain and spinal marrow, as described till now, show, in their course on both sides, symmetrical order, and in their trunks, at least in different human bodies, much consistency and similarity of formation. We find, however, in the interior of the chest and the cavity of the abdomen, another nervous system, different from the former, and which possesses neither the symmetritrical order of the nerves of the senses and limbs, nor any consistency in formation. For it is frequently, not only in its branches but also in its principal masses and beginnings, entirely different in the bodies of two or more men, like the higher regions of our race, which in different individuals, are wholly different and form, consequently, the basis of a characteristic variety in the human race.

Like the single knot of nerves in the body of the insects and mollusca, we see in the neighborhood of the stomach, the lungs, the heart and the beginnings of its vessels, and in the centre of the other interior organs, which are immediately instrumental in digestion and nutrition, compressions and gyrations of nerves. which are even connected with the fifth and sixth pair of cranial and the most extreme pair of vertebral nerves, and with the system of the brain and spine. The superior plexus colli of the system of *sympathic* nerves is changed in different human bodies, as regards length, from two twelfths of an inch to three inches and ten twelfths. This division conducts sometimes but one or two, at other times five or six tender, red, vasal nerves to the *carotis* which accompany the latter to the confines of the brain. And thus increases the variety in form, dimension, situation, etc. etc.; also in the other ganglia of the *thorax* and *abdomen*, and finally those threads only remain unchanged which run from the nerves of the spinal marrow to the sympathic nerve.

The destination of the gangliar system is evidently, to endow the chief organs of digestion and nutrition with the animating influence. The power necessary for doing this it appears to receive not only from the nerves of *will* and *feeling* of the superior order, viz: the brain and spinal marrow, but also like them from a fountain of life, the *physis*.

Free will has no power over the operation of nutrition and formation of the body. The mind in its healthy state knows and feels nothing of the progress of that operation; it feels as little *how* the blood passes through the veins, and food through the organs of nutrition and digestion, as its will can make the heart beat and the stomach digest. The sick state in which we feel every motion of the heart and intestines more or less painfully, shows what nutrition and digestion would be, if their progress were dependant *only* on the superior region of will and feeling.

But as it is, the circulation and productive functions proceed without interruption during a state of sleep, paralysis, and even partial destruction of the superior system of nerves; and we can in the gangliar system of the human body, perceive the immediate influence of those cosmic powers, which impel the animal in which this system is predominant, to the unconscious motions and actions of instinct. The superior nervous system which proceeds immediately from the brain and medulla spinalis, is the support and mediator of the superior human life, of voluntary motion and distinct sensations. Voluntary motion seems to be the consequence of a current *downwards;* sensation that of a current *upwards*, of the *vis vitalis* in the nerves. As a proof of which we might quote the oft repeated experiment, according to which, in a bound up nerve, by an external irritation of the part *below* the bandage, we may cause convulsions, but no sensibility in the muscles, whilst the irritation may be felt in the part *above* the bandage, without causing convulsions in the muscles below.

Very remarkable is the difference in the nature of those two roots with which the nerves originate in the medulla spinalis. That root which runs to the posterior part of the spinal marrow, and which, after its entrance, grows into a knot, appears as the conductor of the feelings; the other root, which runs from the an-

terior part of the spinal marrow in a straight course, without being entangled in the form of a knot, appears as the conductor of the power of voluntary motion.

This has been proved by those observations, according to which, after lesion or destruction of the posterior root, or the posterior part of the medulla spinalis, a cession of sensibility in the resp limb takes place, without interrupting voluntary motion. But in the other case, a destruction of the anterior root, causes a cessation of voluntary motion by the continuation of sensibility.

Life, ascending in the form of sensibility, can, therefore, only approach to its corporeal centre and fountain, the brain and spinal marrow, from behind, and presents before the junction, in the formation of the knot, a similar phenomenon as in the blood vessels, before they enter the brain. The utterance of will passes without resistance through the nerve to the parts below. For the superior, which descends to the inferior, penetrates the latter with predominating power; the inferior, on the contrary, when it enters the superior, has need of those mediating passages, in which it first changes and surrenders its inferior nature and direction.

That singular symptom of existence in the muscle, *fibratory motion*, where it is immediately communicated to the external surface, appears as *tone*, as *voice*, (the proper functions of the nerves;) and appears in that *upwards*, as light, and in that *downwards* as electricity.

This is the reason why we observe in the *nervus opticus* in the retina of the human eye, and still more of some animals, as phosphoric glimmering, and it seems not unworthy of our notice, that the so called *clairvoyants* describe the nerves of the living body as shining threads, which pass through the darker forms of the former and illuminate them. But that the other faculty of the nerve, by which it affects the motion of the muscles, is akin to electricity, is evident from the history of the electric fish.

The two above mentioned functions of the nervous system, *sensibility* and *motion*, are not the only ones which it is created for. We may add a third, which by Aristotle is considered as a principal effect of that faculty of the mind, and even as a sign of the more or less vigorous life of the latter, viz. *the creation of heat.*

That idea which owes it origin principally to *Lavoisier*, viz. that animal heat is the consequence of a union of the carbonic gas and the hydrogen of the blood with the oxygen of the atmospheric air, during the process of breathing, has been satisfactorily refuted by Brodie's and Chossal's observations. The creation of heat ceases the quicker, the sooner the influence of the *cerebral nervous* system on the *ganglious system* was suspended by a lesion of the spinal marrow above the fourth vertebræ, although the process of breathing went on as usually.

Oken's, Baumgartner's, and De la Riva's opinion, that animal warmth is produced by a reciprocal influence of the cerebral on the gangliar nerves, in a manner similar to that in which heat is created between two points of wire, which are the means of discharging opposite electricity, seems, therefore not unfounded. Is not this manner to produce heat in its chief features similar to any other, by which, in nature, we see heat produced? The solar light creates heat in the solid rock, because it excites in it an attraction towards a higher centre, different from that which connects the heavy solid bodies of our earth with each other.

Triguration and similar mechanical causes produce heat, because in them there is a tendency to oppose the direction of gravity. The (properly speaking) animal life, which causes sensation and voluntary motion, differs from vegetable life, in as far as it, surrounded by a current of general existance, has a direction not only different from, but opposed to the latter, as we endeavoured to show.

Where, by means of the cerebral nerves, this higher direction crosses the current of the lower, (Physis, according to Muller,) heat will be produced in the stone, the planet like attraction and gravity of which is penetrated by that superior breath which imparts to the sun its light. Heat is every where a solution of the present low contents of gravity by a power which direct the "for something," (ἕνεκα τινος,) which endows things with their existence, to another powerfully attracting centre of co-existence.

Heat is created by an opposition of the different directions in which, every where, the same motion towards a common centre of existence is met, if it seeks the "something for what," now

in this, then in another representation of the "unmoved mover."

During the creation of the shell of that planet which we inhabit, a part of the air which, with a metallic basis, has formed the solid masses of mountains, has been elevated and has become an all surrounding atmosphere. This element, which remains in its original purity and liberty, is therefore the mediating organ, through which the superior cosmic influences are brought to bear on the dark, rigid masses. Here enter the all-warming and illuminating rays of the sun, and the atmosphere is unceasingly agitated by electro-magnetic influences, although this motion of the transparent air-like fluid is only visible to the eye or audible to the ear, when it comes in contact with the rough corporeal masses. Thus appears the mass of nerves in the animal part of the human body, compared with the other parts of it as an original, free and pure life, although this agitation can only be perceived where it makes its exit in the inferior members. And, like the light of the sun, which, pervading the atmosphere, covers the whole surface of the planet, so does that life, which runs in the nerve, influence even the destroyed and separated member with its single parts, for that inner siderial body, which meets and joints here the exterior, can not be injured by any physical power.

And so the nervous system is, as far as regards motion and sensibility, the corporeal image of a reciprocal influence, on which the life of the mental region depends; the image of a love, descending, comprehending and moving the corporeal, and of a longing which ascends and gradually changes the lower nature into the superior.

The assertion that the development and activity of the single mental faculties are connected with particular parts of the brain, has been made by several German physiologists, however singular and gross the ideas of such a reciprocal relation may have been.

Benivenius asserted the existence of some relation between *memory* and the *cerebellum*, after a lesion of which the former was said to have disappeared. He thought that the number of leaves in the cerebellum was in accordance and proportion to the nature and distinction of the intellectual faculty.

Schellhammer endeavored to establish a connexion between the *faculty of perception* and the *tuber cinereum*, and the greater circumference of marrow.

Willis thought there existed a relation between *imagination* and the *commissura magna*, *instinct* and the *anterior part* of the *eminentia quadrigemina*, the *passions* and the *pons varolii*.

Landrisi, between the *faculty of judgment* and the *glandula* pinealis.

These assertions, whatever be their real value in science, can not but be considered as forerunners to the light, which the discoveries and observations of Gall, Spurzheim, and others, shed over the important organs of the brain and spinal marrow.

You are well acquainted with the improvements the science has undergone and still undergoes, and it is to be hoped that those who study it, will never leave the path of inductive philosophy, the only one which leads to sound and satisfactory conclusions.

I beg leave to enjoy your patience a few moments longer, to direct your attention to a fact, which has been brought to bear against phrenology by its opponents; I mean the fact that individuals lost quantities of the cerebral substance, without any apparent injury to their intellectual faculties.

This fact may at first startle us, but if we look more minutely into it, our astonishment, if there is any, will soon cease.

The organs of the brain exist, as we have seen doubly. It is, therefore, not impossible that one hemisphere of the brain should be active, even if the other were diseased or irretrievably hurt by a mechanical lesion. We do not want analogies in nature. Can not one optical nerve be entirely destroyed, without injuring the other? Can not one ear loose entirely the faculty of hearing, whilst the other is as sound as could be wished.

But I feel the necessity of concluding, although I am fully conscious, how little the subject is exhausted and how much might be said in further illustration of it; but as I never intended more than a slight sketch, I shall be happy, if as such, my remarks have been able to satisfy you.